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USSR Report

ENERGY

No. 72

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FUELS

STEPS OIL INDUSTRY SHOULD TAKE TO FULFILL NEW FIVE-YEAR PLAN OUTLINED

Moscow NEFTYANIK in Russian No 6, Jun 81 pp 2-4

[Article by V. I. Igrevskiy, first deputy minister of Petroleum Industry: "The Extent of Our Tasks"]

[Text] The 11th Five-Year Plan is the first step in realization of the energy program developed at the initiative of CPSU Central Committee General Secretary, Chairman of the USSR Supreme Soviet Presidium Comrade L. I. Brezhnev. The main principles of this program--a thrifty and economical attitude toward petroleum resources, a rise in the degree of use of petroleum reserves, and a reduction in the consumption of petroleum as a boiler fuel--are close to us oilfield workers, and we understand them.

During the last five-year plan oilfield workers made a worthy contribution to the enormous constructive work of the Soviet people. Having assimilated tens of billions of rubles of capital investment, the oilfield workers provided for an absolute growth of about 130 million tons in the recovery of crude oil and gas condensate during the five-year plan. Well penetration exceeded the five-year plan goal by 5.4 million meters. New capacity for treating 13.5 billion cubic meters of casing-head gas per year was put into operation, exceeding the amount of the gas used. The length of trunk oil pipelines was increased by 12,500 kilometers, sharply reducing petroleum hauling by rail.

The major complex of social measures aimed at further improving working and living conditions and recreation for oilfield workers, raising the skill levels of personnel, and creating a good socio-psychological climate in the labor collectives that was implemented during the five-year plan was reflected favorably in the results of the industry's activity.

The industry's workers carried out successfully the 25th party congress's instructions to develop the oil industry in West Siberia. Almost 313 million tons of fuel were recovered there, exceeding the goal for the 10th Five-Year Plan.

Well penetration in Tyumenskaya Oblast more than tripled. This was the result of the work of a multithousand collective of drillers not only of Tyumen', but also of Tataria, Bashkiria, the Ukraine, Belorussia and Saratovskaya and Kuybyshevskaya oblasts, and also of construction and transport workers and the many other production collectives of the country that are supplying the oil and gas complex with machinery, equipment and materials.

The 26th party congress planned to bring the recovery of oil and gas condensate in the country during the five-year period up to 620-645 million tons, including 385-395 million tons of it from West Siberia. The oil and gas recovery industry in the Kazakh SSR and the north of the European part of the country should be further developed.

The tasks set by the congress are very important and require strenuous work by all oilfield workers' collectives. In order to accomplish these tasks it is necessary to introduce many new fields into the developmental stage and to greatly increase the amount of drilling by raising its technical and economic indicators, reequipping it with machinery, increasing labor productivity, and improving the organization of drilling.

New methods for stimulating petroleum formations in order to increase the withdrawal of crude are to be introduced on a broad scale, highly productive methods for operating wells--the use of gaslift and of submersible electric pumps--are to be developed, and labor expenditures per well are to be reduced through further development of the integrated method for automating oilfield facilities.

In order to realize the 1981 plan to recover 589 million tons of crude oil and gas condensate, the Ministry of Oil Industry is to allocate capital investment in an amount that will exceed the 1980 level by 14.5 percent.

It is planned to drill in 1981 more than 20 million meters of boreholes, to build many oilfield facilities for improving the gathering and treatment of the wells' output, to put 3,000 kilometers of trunk oil pipeline into operation, and to build more than 900 kilometers of roads.

In order to improve the oilfield workers' social and living conditions, 1.8 million square meters of housing, institutions for 10,500 children and preschoolers, schools for 11,000 pupils, and vegetable storage in the amount of 5,500 tons are to be put into operation, and a general merchandise warehouse more than 6,000 square meters in area and many other facilities for the most varied purposes are to be built.

Thus, in 1981, a strong base is to be established for fulfilling unconditionally tasks for developing the country's oil industry during the 11th Five-Year Plan.

Reaching the goals set by the party are linked with many aspects of our industry's activity.

The oil industry's advancing development requires constant augmentation of the raw materials base with new explored reserves, the creation of oil-recovery capacity through drilling, the introduction of new wells into operation, and the construction of facilities for the integrated buildup of the oilfields and the involved area in general. Enormous financial, supply and equipment resources are being allocated for strengthening the industry's raw-materials base.

Concern about preserving a high level of oil recovery should be closely tied in with the growth of reserves and with assuring successful execution of the planned amount of geological and geophysical operations.

Things are going well in this regard in Bashneft' [Bashkir Oil Production Association] and Grozneft' [Groznyy Oil Production Association]. However, there are also

other examples. Embaneft' [Emba Oil Production Association] is not carrying out plans for drilling highly promising subsalt deposits and many defects are being permitted in the construction of exploratory holes. Promising fields that have been discovered by single holes still have not been evaluated and cannot be put into development. The effectiveness of exploratory work is low--this is because of inadequate reliability of the geophysical data--in West Georgia, Azerbaijan and Krasnodarskiy and Stavropol'skiy krays.

The collectives of these and of other associations upon which the potential for growth in new oil reserves directly depends (Turkmenneft' [Turkmen Oil Production Association], Permneft' [Perm' Oil Production Association], Mangyshlakneft' [Mangyshlak Oil Production Association] and Glavtyumenneftegaz [Main Administration for the Oil and Gas Industry in Tyumenskaya Oblast]) should devote the most tireless attention to this aspect of the work.

The 26th party congress pointed to the necessity to improve radically the organizing activity in all elements of managment, to raise the level of and improve the style of management of production, and to increase the output volume through an intensification of production and the economical expenditure of financial, labor and material resources. These are the chief questions for management, and the success of the whole operation depends upon how high is the state of plan, implementational, technological, production and labor discipline in our subunits.

Strict observance of technological and production discipline should be based upon the approved regulations, with provisioning for the observance of all the necessary organizational and technical measures. However, not everywhere are things going like this. Accidents and low-quality construction work are caused by violations of technological discipline during well drilling in Glavtyumenneftegaz, Azneft' [Azerbaijan Oil Production Association], Gruzneft' [Georgian Oil Production Association], Nizhnevolzhskneft' [Lower Volga Oil Production Association], Turkmenneft, and some other associations. Often there are cases at the oilfields where the approach to the selection of equipment has not been thought out well, and wells are not repaired in good time. All this leads to idle time of wells and losses in oil recovery. These deficiencies should be eliminated quickly and effectively.

In order to provide for reliable plan discipline, in light of the CPSU Central Committee and USSR Council of Ministers decree, "On the Improvement of Planning and Strengthening of the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality," a system for technological designing and economic planning has been developed and introduced, and the most important standards documents have been approved.

Measures have also been taken to increase the effectiveness of capital construction and drilling operations, a system of economic incentives for work that will increase the degree of extraction of oil from the ground has been introduced, a plan for improving brigade forms of organization and work incentives has been developed, brigades for oil and gas recovery at the basic production facility have been reactivated, and the foreman's role has been raised.

The petroleum industry has at its disposal a large economic, scientific and technical potential. There is a large inventory of oil wells, more than 2,000 drill rigs, tens of thousands of various mechanisms, motor vehicles and other equipment, large gas-treatment plants, trunk oil pipelines, and plants for repairing equipment and producing special materials.

And this enormous potential should be used effectively. However, not everywhere is this being done in full measure. Here are some examples.

In Nizhnevartovskneftegaz [Nizhnevartovsk Oil and Gas Production Association], Surgutneftegaz [Surgut Oil and Gas Production Association] and Tomskneft' [Tomsk Oil Production Association], the time taken to drill fields over lags behind the stipulated design for development. In Turkmenneft', Mangyshlakneft', Permneft', Azneft' and certain other associations, the work to assimilate waterflood systems lags.

Not everywhere is the research in oilfield hydrodynamics and geophysics being carried out in full unison, and certain scientific-research institutes, geological services, NGDU's [oil and gas recovery administrations] and associations are not using research results completely for analyzing and designing oilfield development.

In Tatneft' [Tatar Oil Production Association], Bashneft' and Udmurtneft' [Udmurt Oil Production Association] the system of planned preventive servicing and of overhaul of wells is well organized, and measures have been adopted for cooperation in the efforts of production elements to increase the operating time of well equipment between repairs. But in certain associations not enough attention is paid to this, as a result of which from 4 to 7 percent of the wells stand idle; this exceeds the operating standards greatly and is 1.5-fold to 2-fold the industrywide average.

There is a similar situation with the inactive well inventory. In the Strezhevoyneft' NGDU of Tomskneft, up to 16 percent of the production wells were idle in 1980, in Kuybyshevneft' [Kuybyshev Oil Production Association] the introduction of wells into operation was hampered, and in Turkmenneft', a large number of wells had collapsed shafts and work on restoring them was being conducted extremely slowly. Work with the well inventory in Glavtyumenneftegaz, where many wells were being operated at less than full yield, was poor.

The main task of collectives of Nizhnevartovskneftegaz and Surgutneftegaz [Surgut Oil Production Association] is to boost the construction and the introduction into operation of flooded wells complexes at the Samotlor and Fedorov fields in 1981. This will enable efficient operation of drowned wells and will improve development of the fields.

The production-well inventory will grow 1.5-fold during the 11th Five-Year Plan. In so doing, the number of wells operated by the mechanized method will be more than 80 percent. This will require a higher level of operation with regard to establishing optimal oil-pumping regimes and improving the technological conditions for use of the equipment. It will be necessary to raise sharply labor productivity in repair work and to improve the quality of repair, with a view to lengthening equipment-operating periods at the wells.

Fulfillment of the plan for oil and gas-condensate recovery will be governed largely by the timely introduction into operation of production and injection wells. During the new five-year plan well penetration will be double that of the preceding five-year plan. It will increase in Komineft' [Komi Oil Production Association], Mangyshlakneft', Orenburgneft' [Orenburg Oil Production Association], Udmurtneft', Azneft', Embaneft' and certain other associations, but especially greatly in areas of West Siberia.

The tasks established for drilling should be carried out by using existing reserves and by providing for a high degree of organization, coordinated and rhythmic work, the timely construction of roads and of earthen platforms under well clusters, the development ahead of time of power-engineering facilities, and precise organization of the supplying of materials and equipment. An important reserve for increasing penetration is a rise in the vocational workmanship of drilling brigades.

The industry has many remarkable drilling collectives, which post truly record work results. Thus, the drilling brigade that G. M. Levin supervises surpassed in 1980 the 100,000 mark for penetration on the basis of, let us note, serially produced equipment. T. A. Anguladze's brigade from Usinsk UBR [Drilling Administration] No 1 accomplishes more than 16,000 meters of penetration per year, where the average for brigades is 9,000 meters. In the Izhevsk UBR the brigades of Yu. G. Gausknekht, V. P. Pisarenko and N. D. Akel'yev reached a penetration of 31,000 meters in 1980, when the average was 23,500 meters per brigade.

An approach by other drilling brigades to these high indicators is an enormous reserve for a further increase in the industry's penetration totals. The experience of the advanced workers should become the property of all brigades.

The amount of capital invested in the petroleum industry for expanding production and creating an infrastructure at new fields and in new regions will increase constantly.

Unfortunately, both the managers of certain enterprises and of scientific-research institutes see new construction, rather than reconstruction and modernization of existing production facilities, as precisely the solution to the industry's problems.

The supervisors of activities must be guided unfailingly by the instructions of the 26th CPSU Congress about aiming capital investment primarily at the reconstruction and reequipping of enterprises. This concerns primarily the so-called "old" oil regions. In the new regions, of course, much work must be done to create new capacity, to build new oilfield facilities. Great attention must be paid in particular to creating and developing road nets. This is one of the key problems in increasing oil-production effectiveness. Without roads it is impossible to develop either construction work or drilling, much less accomplish them effectively.

The construction of housing and cultural and personal-amenity facilities is a major social and economic task, as 26th party congress decisions noted, it being very important to observe an integrated approach in this matter. This means the introduction of housing, children's preschool institutions and facilities for cultural, public-health and household services in good time, as production increases.

Scientific and technical progress is of enormous importance in raising production efficiency.

The industry's most important problems that are to be solved during this five-year plan are amalgamated basically into two major programs:

--the creation and assimilation of technological processes and technical means for drilling oil and gas wells; and

--the creation and wide use of technological processes and technological means for raising oil yield of the beds.

It should be stressed that the influence of scientific and technical progress on the industry's operating effectiveness is intensified if, along with the introduction of new equipment and technology, the operating potential of existing equipment is used completely.

It is also necessary to define with precision the spheres of influence of production organization, on the one hand, and new equipment and technology on the other. This is very important, since one of these concepts often is substituted for the other and, as a result, the desired results are not achieved. As was noted above, collectives of the industry's best drilling brigades, in using serially produced equipment, achieve results that surpass average results by 2-fold or more. And, at the same time, cases are known where use of the highest quality drill pipe and highly productive drill bits did not bring a rise in technical and economic indicators because of poor work organization.

Examples can also be cited from the area of oil recovery where the use of new technical means and technological processes improved indicators appreciably in one case but in another case did not. Thus, in recent years the technical level and quality of UETsN's [electrical centrifugal pump installations] was raised somewhat (although the oilfield workers, as before, had complaints against the subcontractors), but even in advanced associations the operating period between repairs was less than, let's say, in Tataria, where last year it reached 336 days (285 in Bashneft', 251 in Permneft' and 190 days in Nizhnevartovskneftegaz). This difference is explained by the level of organization of operations and the responsibility of the operators.

The industry did definite work under the program of measures that had been developed to raise formation productivity. At the same time, because of inadequate persistence on the part of the management of the NPO [science and production association] Soyuztermneft' [All-Union Association for Use of Thermal Methods for Enhancing Oil Recovery], Mangyshlakneft', Embaneft', Komineft' and Nizhnevartovskneftegaz, not one oilfield in these associations operated in accordance with substantiated designs. A new program was planned for 1981-1985, based upon a comprehensive analysis of the state of affairs in this area. The task of NPO Soyuztermneft' and of all the associations where work is being conducted to raise withdrawal by thermal methods is to carry out the intended measures unconditionally.

The use of chemical methods in well drilling and in recovering crude holds great promise for raising production effectiveness. NPO Soyuznefteprompkhim should stir up more activity in this area.

An important measure that has been called upon to greatly speed up the pace of technical progress in the industry is the conversion of scientific-research organizations and of enterprises to the cost-accounting system of organizing the work to create, assimilate and introduce new equipment on the basis of schedule-orders (or contracts).

And finally, one cannot refrain from speaking about such an important reserve for speeding up economic development as the thrifty and economical use of everything that is at the disposal of the branch and which it is receiving right now from

other branches of industry. Thriftiness is necessary for all, but this does not mean an accumulation of materials and equipment in warehouses; it entails the rational and economical use of them. The industry still has great above-standard residues of uninstalled equipment. The causes of the creation of the surpluses must be analyzed and measures taken to reduce them.

The party and the government are paying great attention to oil-industry development. Oilfield workers experience the needed support and help in all their affairs and initiatives.

Twelve collectives and enterprises have received the award of the challenge Red Banner of the CPSU Central Committee, the USSR Council of Ministers, the AUCCTU and the Komsomol Central Committee with deep gratitude. The title Hero of Socialist Labor was conferred on eight of the industry's workers, and more than 5,500 were awarded orders and medals.

Oilfield workers are responding to the concern and attention of the party and the government with highly productive shockwork. In the first 4 months of the first year of the new five-year plan they recovered 1 billion tons of oil and gas condensate above the established plan.

Guided by the decree of the CPSU Central Committee, the USSR Council of Ministers, the AUCCTU and the Komsomol Central Committee, "On All-Union Socialist Competition for Successful Fulfillment and Overfulfillment of 11th Five-Year Plan Tasks," the industry's laboring collectives are full of resolve to attain the high labor rhythm that was engendered by the precongress socialist competition, to provide for the timely introduction into operation of all the facilities planned, and to create all the prerequisites for the further forward development of the oil industry, in full accord with the historic decisions of the 26th congress of the Communist Party.

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EXPLORATION FOR GAS CONTINUES IN UZBEK SSR

Moscow PRAVDA in Russian 5 Jul 81 p 2

[Article by T. Romanovskaya (Karshi, Kashkadar'inskaya Oblast): "Shurtan's Gas"]

[Text] The Gazli gas field was discovered in West Uzbekistan in the middle of the 1950's. It was then considered the country's largest. A gas-recovery industry was established on the basis of its reserves, and life in these areas began to travel "on the fast track."

Since then tens of oil and gas fields have been discovered in the region. Prospecting and exploration, which Uzbekneftegazgeologiya [Uzbek Association for the Exploration of Oil and Gas Fields] is conducting, covered an area of more than 120,000 square kilometers.

"We carried out the 10th Five-Year Plan in all indicators," says B. Telegin, chief engineer of the association. "Eighteen new oil and gas fields were discovered, six more than during the Ninth Five-Year Plan. Thanks to these discoveries, the five-year plan goal for growth in gas reserves was fulfilled 146 percent."

Shurtan gas comes to the Syrdar'inskaya GRES, which should play an important role in further transforming the Karshi steppe and neighboring southern regions, over a 400-kilometer gas pipeline.

"The Main Directions for the Economic and Social Development of the USSR During 1981-1985 and During the Period up to 1990" states: "...Take steps to find oil and gas deposits...in Central Asia." This task presupposes prospecting and exploration for minerals not just in known oil and gas bearing areas. Little time will pass before the first drilling derrick will rise up on Shaytankala Island, which is in the middle of the Barsakel'mes salt lake, at Ustyurt. Airplanes will deliver rotating-duty type personnel here. It is planned to start geological exploration also in the Surkhandar'ya depression, where the prospects for the discovery of new fields also are assessed highly.

"It is complicated to drill in our districts. In many places where we sink wells, we have to deal with anomalously high formation pressures, which at times exceed the norms 2½-fold," says drilling foreman of the Gissar Oil and Gas Exploration Expedition, deputy of the USSR Supreme Soviet A. Tilavov, whose brigade works at Shurtan right now. "This requires not only special equipment, which protects against random blowouts of gas, but, the main thing, special vocational skill of the drilling operators."

In deep drilling, the association's average annual penetration per brigade has increased by more than 600 meters in comparison with the end of the last five-year plan.

The introduction of new equipment and advanced drilling technology has helped to raise labor productivity in Uzbekneftegazgeologiya collectives. In the last 5 years the economic effectiveness from their use has been about 9 million rubles. Let us state that the apparatus for automatically filling up the well that the Uzbek SSR Ministry of Geology developed allows the amount of drilling mud in the hole to be regulated, equilibrates the formation pressure and does not allow the gas to escape outwards. It is regrettable only that all the innovations are still being made literally in single copies.

...When I left the Shurtan area, the dark Asian night had already enshrouded everything around with its black veil, strewn with bright stars. The lighted drilling tower was visible for a long time. I thought: not all the underground storehouses here have opened up their secrets. But one can rest assured that they will, without fail, throw open their doors to the courageous seekers of underground treasuries.

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NEW UKRAINIAN COAL MINE PLEDGES TO REACH RATED CAPACITY A YEAR EARLY

Kiev RABOCHAYA GAZETA in Russian 2 Jul 81 p 1

[Article by representatives of the collective of the Komsomolets Donbassa Underground Mine of the Shakhterskantratsit Association: "Every Longwall Should Reach Design Capacity"]

[Text] The collective of the Komsomolets Donbassa coal mine of Shakhterskantratsit [Shakhtersk Anthracite Coal Production Association] has come out with the initiative to attain the enterprise's design capacity a year ahead of schedule, and it has called upon the republic's miners to do everything possible to assure that there is not one lagging longwall during the current five-year plan.

For a year and a half now the collective of the Komsomolets Donbassa Underground Coal Mine has been giving the country fuel. Five longwalls are equipped with the SO-75 overhead cutter, IK-101 continuous longwall mining machines and KM-87 UME and KM-88 mechanized roof supports, by means of which brigades of mineworkers at the breakage face send to the surface each day as much as 2,000 tons of anthracite. In all, since the start of the year, the mine has given the country's economy more than 260,000 tons of high-quality power-generating fuel and thus has become a full-fledged element of the fuel complex, and it is working on the five-year plan.

It is important to note here that the heroic style of work is reflected even in the first line of the workers' biography of the new Donbass coal enterprise. The mine, which then bore the name, "Zhdanovskaya-Kapital'naya No 1," went into operation a whole year ahead of the standard date. Comrade L. I. Brezhnev's greeting on this occasion stated in particular that for the first time in domestic underground-mining construction practice, a highly mechanized complex for mining and preparing 2.1 million tons of anthracite per year had been erected and successfully put into operation in such a short time.

Comrade L. I. Brezhnev further wrote: "It is pleasant to note that the operators have taken up the relay baton of the builders in the precongress competition and resolved to send 100,000 tons of high-quality anthracite to the customers by the day of the opening of the 26th CPSU Congress...."

Our mine collective kept its word and carried out its commitment. And the kind words that Leonid Il'ich addressed to our collective became an injunction. We

decided to carry further the relay race of labor achievement that the underground minebuilders had adopted; and in response to the 26th CPSU Congress decisions, we will undertake to assimilate the design capacity of the Komsomolets Donbassa Underground Mine a year ahead of schedule, that is, to reach the goal of 2.1 million tons of anthracite not in 1986 but in the concluding year of the 11th Five-Year Plan.

We recognize that the task that the collective has set for itself is not a simple one. Its solution requires of each wageworker, specialist and engineer, and all the enterprise's workers a redoubling of effort and high effectiveness and quality of work. For we must provide for an increase of 300,000 tons in the amount of fuel mined per year, which is 14.3 percent of the design capacity of the mine's first phase.

Still another important prerequisite for successful achievement of the intended goal is a precise program of actions. We have such a program. This is an integrated plan of engineering and economic measures for assimilating design capacity ahead of schedule. It includes the engineering development of specialists of the mine and of Shakhterskantratsit, the recommendations of scientific-research and design institutes, and the proposals that the enterprise's workers expressed when the integrated plan was discussed at workers' meetings, and also at the minewide party meeting which approved it.

Component parts of the integrated plan are calendar schedules for assimilating design capacity, for the conduct of mine tunneling, and for movement of the breakage faces. It also includes basic measures for improving technical and economic indicators and technical progress. In particular, the calendar schedule for the conduct of mining tunneling covers work on the reproduction of the breakage line of the mine face, preparation of the second southern longwall of seam L3 of block No 1, the first west longwall of seam L7 of block No 3, preparation of the second and third northern longwalls of seam L7, and other longwalls, and a set of operations for buildings and structures on the surface. Altogether, about 120 different types of operations were included. All of them were added up as to amounts and costs, and the deadlines for carrying them out and the persons who were to carry them out were indicated. In all, it is required that almost 55 kilometers of tunneling be done, and a large amount of mining equipment be assembled and that it be incorporated in the operations.

In our concern about developing the mine, we did not forget such important questions as improving the miners' working conditions, making the work easier and increasing comfort and work safety. During these years we plan to introduce another four SO-75 overhead cutters, the same number of units for digging out recesses, eight KSU-3 conjugate supports, four BU-1 drilling units, a 4PP-5 drifting cutter-loader for tunneling along outburst-prone seam L3, sectional trains, eight 2LL-100 belt conveyors for delivering people to mine f ces, and a number of other new machinery and mechanism resources, which reduce the amount of manual labor, increase labor productivity and provide for a high degree of protection at the workplace.

Relying upon a precise calculation, today we can say how breakage faces will move during 1981-1985 and how the workload at the longwalls and coal mining as a whole throughout the mine will grow. This year it will be 835,000 tons, in each of the next 2 years the mine will produce 1.08 million tons of anthracite, 1.48 million

tons in 1984, and, in the concluding year of the 11th Five-Year Plan, 2.1 million tons versus the designed task of 1.8 million. That is, the mine will assimilate the designed capacity of the first phase.

Our mine's collective is young. An overwhelming number of the miners are of Komsomol age, and a portion of them still have not gained enough work experience. Therefore, with a view to increasing vocational skills at the mine, a mentors' institute has been created at the mine, and in the execution of complicated engineering operations we count upon the help of scientists and scientific workers of the industry's institutes. For this purpose the mine has concluded agreements on creative collaboration with DonUGI [Donets Scientific-Research Institute for Coal], Dongiprouglemash [Donets Branch of the State Design-Development and Experimental Institute for Coal Machinebuilding], Dongiproshakht [Donets Branch of the State Institute for the Design of Underground Mines], Voroshilovgrad Scientific-Research Institute for Small-Scale Mechanization, and other scientific-research and design institutes, and the Druzhkovka Machinebuilding Plant, which makes mechanized supports, and the Yasinovataya Machinebuilding Plant, which supplies tunneling units to the miners. From the latter we expect primarily regular deliveries of new machinery and of spare parts for the machines and mechanisms that we are already operating. This will allow preventive repair to be accomplished better, accidents with equipment to be avoided, and a high rhythmicity of operation of the longwalls being mined and of rock faces to be provided for.

We assess highly the work of the minebuilders, who put no small amount of effort into building our mine and putting it into operation a year ahead of time. But aside from the industrial complex, the concept of a mine also includes housing and facilities for social, cultural and personal-services purposes. Introducing them into operation still lags behind schedule, and we hope that the prime contractor--Donetskzhilstroy [Donets Housing-Construction Combine]--will, in the near future, make up for what has been neglected. This will enable the question of personnel retention to be solved more successfully. We still do not have enough engineers and technicians, and we expect help from Shakhterskantratsit and UkSSR Minugleprom [Ministry of Coal Industry] in solving this problem.

The 26th CPSU Congress noted how important it is for the country's economy to provide for the timely introduction of fixed capital and productive capacity into operation and to successfully assimilate it. At the same time, we know that some of our republic's mines, and also some mine sections, cannot for various reasons come up to the designed level for a long time. Therefore, in taking upon ourselves the commitment to assimilate the design capacity of the first phase of Komsomolets Donbassa a year ahead of schedule, we call upon the collectives of other mines and sections to follow our example and make every effort to insure that none of the republic's coal enterprises or subunits thereof fails to assimilate its designed capacity during this five-year plan. Doing so means the addition of millions of tons of coal that are so necessary to the country's economy for more complete satisfaction of the needs of developing branches of industry that use coal as a raw material or as a fuel.

In the name of the Komsomolets Donbassa collective of Shakhterskantratsit: M.M. Shcherbak, party bureau secretary; S. V. Karpyak, chairman of the mine's trade-union committee; N. A. Sokolov, brigade leader of a breakage face of section No 2 and Hero of Socialist Labor; D. N. Rebrov, brigade leader of mineworkers of section No 2; N. M. Shcherbinin, brigade leader of mineworkers of section No 4; V. E. Gritsuk, tunneler; L. M. Babak, mineworker of a breakage face of section No 1; and V. Ya. Chukhutov, mineworker of a breakage face of section No 2.

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LEADING UKRAINIAN COAL MINE WORKERS, STATISTICS CITED

Kiev UGOL' UKRAINY in Russian No 6, Jun 81 pp 1-3

[Article by A. A. Manzhula, deputy minister of the UkSSR Ministry of the Coal Industry: Coal of the Brigades of Leading Workers"]

> [Text] Guarantee an increase in the volume of extraction and processing of coal mainly by improving labor productivity. Main Directions of Economic and Social Development of the USSR for 1981-1985 and for the Period to 1990

During the 10th Five-Year Plan, the republic miners supplied the country's national economy with over 1 billion tons of fuel, including 278.9 million tons of coal extracted by the brigades of leading workers. After extensively evolving socialist competition to improve the efficiency and quality of work, by creatively using the leading experience of labor organization and by perfecting their occupational skill, the leading collectives of extracting brigades in the Ukraine reached high production indicators in 1980.

In 1980, over 140 brigades working on beds of average thickness participated in the socialist competition for reaching a 1000-ton load on the longwall. Two hundred brigades working on thin sloping and inclined beds competed for the mastery of a 500-ton load on the longwall, and 265 brigades competed for rapid making of the shafts. The load of 1000 T of coal and more per day on the longwall was reached by 111 brigades, 180 brigades provided a load of over 500 T per day, while 248 tunneling collectives mastered the high-speed method of making shafts.

The brigades of leading workers made a weighty contribution to the work of the republic's coal industry. In 1980 111 brigades extracted 49.5 million tons of coal, including 1.7 million T above the plan. One of the main indicators which characterizes the results of work of the brigades of leading workers is the daily average load on the stoping face. It is 4 times greater than the average for the branch and was 1368 T. Of the total number of brigades of leading workers, 86 guaranteed a daily load on the longwall of 1000-1300 T, 16--1300-1500T, 4--1500-2000 T, and over 2000 T--5 brigades.

The highest daily average load on the longwall in 1980 was reached by the brigades of the stoping face miners headed by Hero of Socialist Labor, Lenin Komsomol Prize laureate V. G. Murzenko from the mine "Krasnyy partizan" (association Sverdlovantratsit) of 3979 T. The honored miner laureate of the Lenin Komsomol Prize N. N. Skrupnik from the mining administration imeni Frunze (Roven'kiantratsit) reached

3056 T. The honored miner V. I. Ignat'yev from the mine "Krasnolimanskaya" imeni 50-letiya Velikoy Oktyabr'skoy sotsialistechskoy revolyutsii (Krasnoarmeyskugol') reached 3035 T and Hero of Socialist Labor, USSR State Prize laureate A. D. Polishchuk from the mine "Trudovskaya" (Donetskugol') reached 3001 T. Each of these brigades extracted over 1 million tons of coal during the year.

High daily loads on the longwall were reached by the brigades headed by Hero of Socialist Labor A. Ya. Kolesnikov from the mine "Molodogvardeyskaya" (Krasnodonugol'), 2607 T, by the honored miner P. A. Mar'yanenko from the Kosmonavty mining administration (Roven'kiantratsit), 1797 T, Hero of Socialist Labor A. A. Asyutchenko from the mine imeni gazeta "Sotsialisticheskiy Donbass" (Donetskugol'), 1770 T, V. I. Yerokhin from the mine "Belozerskaya" (Dobropol'yeugol'), 1743 T, honored miner G. Ye. Abramov from the 25th CPSU Congress mine (Makeyevugol'), 1688 T, honored miner I. F. Manekin from the Zasyad'ko mine (Donetskugol'), 1623 T, Hero of Socialist Labor, Lenin Komsomol Prize laureate G. I. Motsak from the Kosmonavty mining administration (Roben'kiantratsit), 1497 T, G. G. Avraimov from the RKKA mine (Dobropol'yeugol'), 1484 T, State Prize laureate, honored miner of the UkSSR V. I. Pinchuk from the mine "Odesskaya" (Sverdlovantratsit), 1453 T, and N. S. Shkolyarenko from the 25th CPSU Congress mine (Ukrzapadugol'), 1443 T.

An important indicator which characterizes the work of the brigades of leading workers is labor productivity. In 1980, the average monthly labor productivity in the 111 brigades who reached coal extraction from the stoping face of 1000 T and more per day was 342.3, i.e., 3.1-fold greater than the labor productivity for stoping operations in the sector.

The movement to extract 1000 T of coal per day from the longwall and attainment of monthly labor productivity for one worker brigade of 500 T and more were popular among the brigades of leading workers. Eleven brigades worked with this productivity in 1980. The highest results for labor productivity were attained by the collectives led by P. A. Kaminskiy from the mine "Butkovka-Donetkaya" (Donetskugol'), 818.8 T, V. I. Ignat'yev from the mine "Krasnolimanskaya" imeni 50-letiya Velikoy Oktyabr'skoy sotsialisticheskoy revolyutsii (Krasnoarmeyskugol'), 810.3 T, V. I. Orlovskiy from the mine "Verbolozovskaya" (Aleksandriyaugol'), 582.3 T, V. A. Buymistruk from the mine No 3 "Velikomostovskaya" (Ukrzapadugol'), 575.4 T, A. I. Kapelyukh from mine No 5 "Velikomostovskaya" (Ukrzapadugol'), 563.1 T, Yu. V. Grebennik from the mine imeni 50-letiya SSSR (Ukrzapadugol'), 557.4 T, P. A. Mar'yanenko from the Kosmonavty mining administration (Roven'kiantratsit), 541.8 T, A. A. Ovchinnikov from the 25th CPSU Congress mine (Ukrzapadugol'), 534.1 T, A. T. Koshkin from the mine "Butovka-Donetskaya" (Donetskugol'), 528.3 T, V. I. Rybinskiy from mine No 3 "Velikomostovskaya" and N. S. Shkolyarenko from the 25th CPSU Congress mine 526 and 522.5 T respectively.

The highest technical and economic indicators were obtained by the brigades in the longwalls equipped with mechanized complexes. Thus, 101 faces where the daily load was 1000 T of coal and more, were equipped with mechanized complexes, including 75 faces with KM-87, 15 with KMK-97 and MKM, 6 faces with "Donbass" and 5 with OKP. With accurate organization of work, the 1000-ton load was mastered in 10 faces that were equipped with combines and individual timbering.

The results of the work are significantly influenced by the length of the longwall and the thickness of the bed. The range of longwall lengths with 1000-ton load is fairly broad. Longwalls with length of 100-250 m operated with a high load. The

greatest specific weight (55.9%) were longwalls with optimal length of 150-200 m. The distribution of longwalls with 1000-ton load according to bed thickness is as follows: 34 longwalls (30.6%) worked beds 0.7-1.2 m thick, 55 (49.6%)--1.21-1.8 m thick, and 22 longwalls (19.5%)--over 1.8 m thick. The largest loads were observed in the longwalls that worked beds 1.2-1.8 m thick.

Special attention should be given to the work of the 34 leading collectives who reached a daily load on the longwall of 1000 T on beds up to 1.2 m thick. A stable high daily load on the longwall on thin beds 0.9-1.2 m thick was achieved by the brigades of the stoping face miners headed by I. M. Lisovskiy from the mine "Voroshilovgradskaya" No 1 (Voroshilovgradugol'), 1350 T, P. S. Onoshchuk from the mine "Krasnoarmeyskaya" (Dobropol'yeugol'), 1312 T, N. I. Lakushev from the mine "Krasnoluchskaya" (Donbassantratsit), 1269 T, A. I. Tkhor from the Fruzne mining administration (Roven'kiantratsit), 1229 T, Hero of Socialist Labor A. A. Akimov from mine No 8 "Velikomostrovkaya-Komsomol'skaya" (Ukrzapadugol'), 1149 T, V. I. Lapay from the Sverdlov mine (Sverdlovantratsit), 1107 T, P. Ye. Venger from the mine "Vinnitskaya" (Shakhterskantratsit), 1028 T. Organization of the work of the brigades on the thin sloping and inclined beds is distinguished by special complexity. The experience of these brigades is very valuable for dissemination in analogous conditions.

The leading collectives have achieved high results of work because of the good engineering preparation of the extraction sections, perfection of the production processes, maximum mechanization and reduction in the number of auxiliary operations, skilful use of equipment, and accurate organization of labor. The model attitude towards work and the rich experience accumulated in the leading collectives should be disseminated in every possible way in the coal industry and should become the property and standard for all.

However, in the 10th Five-Year Plan the experience of the leading collectives was not sufficiently disseminated and the necessary volume of organizational work was not done. Although the number of brigades of leading workers increased in 1980 as compared to 1979 (from 105 to 111), in the last 3 years a tendency was observed towards a decline in their number as opposed to that attained in the beginning of the five-year plan. This is explained by a deterioration in the mining geological conditions, the transition of individual mines to excavation of thin beds, expansion of the area of application of mechanized complexes to thin beds with a lower load, etc. The main reasons for the decline in the load on the longwall are: unsatisfactory use of equipment, engineering miscalculations in preparing the excavation sections, insufficient attention to the study of and dissemination of the experience of the leading collectives, and low level of labor organization in individual brigades. Certain leaders of the associations and mines do not focus proper attention and do not create conditions for an increase in the number of brigades who guarantee high loads on the longwall.

The UkSSR Ministry of the Coal Industry gives primary importance to the movement to increase the number of brigades of leading workers and the brigades with 500-ton load on the longwall on the thin beds. A republic conference of the leaders from the leading extraction sections and brigades took place in Donetsk on 10 January 1981 with the participation of members from the UkSSR Ministry of the Coal Industry. Results were summarized for the work of 1980, shortcomings were revealed and measures were planned for the further spread of leading experience, improvement in efficiency and quality of work, and for the successful fulfillment of plans and

assignments of 1981 and the 11th Five-Year Plan. It is stipulated that as a result of reducing the intrashift standstills, improvement in the quality of repairs, introduction of the experience of the leading collectives, and development of socialist competition, the daily average load on the stoping face would be increased by 10%, the monthly rates of tunneling shafts for coal would be brought to no less than 200-300 m, and for rock to 120-140 m. An assignment was set for 1981 for 125 extraction brigades to guarantee a load on the longwall of 1000 T and more per day, for 200 brigades to supply 500 T and more per day on thin beds, and for 270 tunneling brigades to make shafts by the high-speed methods. An appeal was adopted from the leading workers of socialist competition to all miners of the Ukrainian SSR to increase the efficiency of coal extraction and making of the mine shafts. The board of the UkSSR Ministry of the Coal Industry obliged the leaders of the associations to acquaint all the workers, engineering-technical workers and clerical staff of the enterprises and organizations with this appeal.

The leading collectives of the republic mines are currently working on implementing the decisions of the 26th CPSU Congress. We should note the great educational work of twice Hero of Socialist Labor I. I. Strel'chenko who previously headed a brigade and now heads a section in which the brigade of A. D. Polishchuk (mine "Trudovskaya") works. The section has become a school for the leading experience for all brigades of the branch working under similar conditions. Workers of many enterprises have come to the mine, and after seeing the difficult conditions under which this remarkable collective has achieved success, they armed themselves with their exeprience. I. I. Strel'chenko was a delegate to the 26th CPSU Congress and the 26th Congress of the Ukrainian Communist Party. The following best representatives of the brigades of leading workers were also delegates to the 26th CPSU Congress: A. A. Asyutchenko, P. S. Negrutsa, A. Ya. Kolesnikov, V. R. Kuzovkov, V. G. Murzenko, G. I. Motsak, and to the 26th Congress of the Ukrainian Communist Party, brigade foremen of the stoping face miners: A. Ye. Abramov, A. I. Belikov, V. V. Bad'in, P. Ye. Venger, M. P. Vasil'yev, P. N. Goncharuk, I. I. Dyachenko, A. D. Polishchuk, V. N. Pikhterev, N. N. Skrypnik and I. D. Yavorskiy. Their names are known not only in the republic, but in the entire country.

In the socialist competition for a worthy meeting of the 26th CPSU Congress and the 26th Congress of the Ukrainian Communist Party, many collectives attained high labor indicators. The brigades of leading workers successfully fulfilled the commitments, worked intensively on the days of work of the party congresses. In only 3 months of 1981, they extracted 12.2 million tons of coal, including 737,200 T above the plan. The task of the leading collectives and all miners of the branch is to preserve the high rhythm of work throughout the year as in the days of the pre-congress labor watch.

It is planned by the end of the 11th Five-Year Plan to bring the number of brigades that guarantee a daily load on the longwall of 1000 T of coal and more to 150, and a load of 500-700 T and more on thin sloping and inclined beds to 230. It is planned to organize making of shafts by the high-speed method by 275 brigades.

In order to fulfill the planned assignments, it is necessary to aim all efforts and attention on increasing the coal extraction, improving the technical-economic indicators of the sector work, and elimination of deficiencies. The primary role is given to the leading workers and innovators of production whose experience must become the property of all mining collectives of the republic.

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EXPERIENCE IN OPTIMIZING SYSTEMS FOR DEVELOPMENT OF ROMASHKINSKIY FIELD

Moscow NEFTYANOYE KHOZYAYSTVO in Russian No 12, Dec 80 pp 27-34

[Article by R. Kh. Muslimov, Tatneft': "Experience in Optimizing Systems for the Development of the Romashkinskiy Field: Discussion of the Problem of Condensing the Well Network Raised by Academician A. P. Krylov in the Article Published in the Journal NEFTYANOYE KHOZYAYSTVO, No 6, 1980"]

[Text] Advances in developing the oil industry have been linked in the postwar period by certain researchers mainly with the thinning of the well network. It is noted in particular in article [2] that when only flooding is used and the dense networks are kept and the rates of drilling are preserved, the oil extraction would be 3 times lower than the actual. However, when the extant well network and the rates of drilling out are maintained, but flooding is not used, extraction of oil at the Romashkinskiy field would be 5 times lower than the actual. Consequently, flooding does not play a secondary role.

The principles of efficient development were not sufficiently theoretically substantiated in the planning of development of the Romashkinskiy field with the use of flooding methods. The following are the main shortcomings of the first general plan compiled in 1954 when there was not any experience.

1. Excessive enlargement of the operational facility (unification of up to six-eight productive beds that were distinguished 15-fold in permeability). Studies showed that it was necessary from the very beginning to separate the upper discontinuous beds on the central fields and the lower beds of the horizontal range that have surface spread, as well as the lower discontinuous beds in the northern areas and bed A which has surface development. It was necessary to use two independent, uniform well networks with distances of 400-600 m between them. This would have permitted the main reserves to be immediately involved in active development and a greater level of oil extraction to be attained 5 years earlier with the same volumes of drilling and outlays.

2. Multistage system of development which provided for stopping the operational series of wells with 50% flooding and switching the injection front after the beginning of flooding to the second series of wells. Although this system was not introduced into production, it resulted in negative consequences. For example, units for preparation of oil and waste water were not built in time and pumps were not made to remove large volumes of liquid in the fields because an insignificant rated flooding was counted on.

premature stopping of the flooded wells is equivalent to thinning their network. This reduces the degree of oil reserve working. Consequently, TatNIPIneft' [Tatar Scientific Research and Planning Institute of the Oil Industry] substantiated the need to operate the wells to an economically profitable limit of flooding (98-99%).

3. Lack of substantiation of the planned sparse networks of wells with their nonuniform arrangement on the field (the distances between the operating rows were greater than between the wells in the rows, while the distance from the injection to the operating rows was double the distance between the operating rows). A final specific density of the network was 32-52 ha/well. In subsequent planning of development of specific areas, a sparser network of wells was used (50-80 ha/well).

Many years of practice of planning the development of oil fields using the criterion of "minimum outlays" shows that the sparser the well network, the better the economic indicators of oil extraction, i.e., it is impossible to set the optimal well grid. It would not be worth mentioning these shortcomings in planning development, if publications [1,2,3] did not defend the principles which are not confirmed by practice, and did not suggest that they be transferred to the development of other fields. This is not done by generalizing the experience and analyzing the development, but based on simplified models and calculations of the effect of well network density on the rates of extraction, based on separately taken indicators (reserves per one well, coefficient of drop in oil extraction, etc.). All of this resulted in the fact that the significant effect of well network density on the output of the deposit and oil output was not taken into consideration.

This is indicated by the formula presented in publication [3] to determine the annual level of oil extraction. It is not applicable to the real conditions of oil occurrence in the beds. According to this formula, with the assigned number of wells, the sparser the network, the greater the oil reserves per one well and the higher the level of oil extraction. This contradicts the practice and experience of developing oil fields. This conclusion is based on the opinion that when the deposit is drilled out in a sparse well network and the system of flooding is used, all the reserves are immediately involved in the working. In actuality, the volume of reserves involved in the working is always lower than those covered by the drilling out. The volume of uninvolved oil reserves is greater the lower the density of the well network and the more nonuniform and separated the beds of the operating facility (table 1).

A natural decrease in the volume of initial extractable reserves (IER) atrributed to one well is noted on the whole for the field. This is not because of condensation of the network, but because of the accelerated working of the highly productive beds and increase in the percentage of difficult-to-extract reserves (low-permeable beds, water-oil zones, lenses).

As a result of this approach to planning the development of the Romashkinskiy field, the planned oil output was not attained. Consequently, (sometimes also to attain even smaller values) and because there was an increase in the level of oil extraction in the subsequent planning documents, a significant change was required in the system of development and an increase in the volume of measures for its improvement.

Table 1.

Indicators,%	Years of Development														
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Romashkinskiy field															
Volume of oil reserves per one extracting well	100	95.1	91.8	90.3	88.7	87.1	85.1	82.7	79.0	74.6	70.5	67.3	64.5	61.6	59.0
Actual volume of oil reserves involved in the development and attributed to one extracting well	100	97.1	95.6	95.8	95.8	95.8	95.2	94.0	91.1	87.2	83.6	80.6	78.1	75.3	72.7
Abdrakhmanovskiy area															
Volume of oil reserves per one extracting well on drilled out sections	100	99.6	96.1	91.1	81.2	72.7	63.3	58.1	55.2	53.0	49.8	46.7	44.3	42.0	39.8
Actual volume of oil reserves involved in the development and attributed to one extracting well	100	98.8	99.3	99.2	98.8	98.4	95.5	91.5	87.4	85.2	81.4	80.0	77.5	74.3	71.6
Chishminskiy area															
Volume of oil reserves per one extracting well on drilled out sections								100	93.8	86.4	80.7	78	74.3	72	70.5
Actual volume of oil reserves involved in the development and attributed to one extracting well								100	98.4	97.3	96.6	95.4	93.3	92.7	92.2

Note: 1964 reserves are taken as 100% (1971 for the Chishminskiy area), the year for the beginning of additional drilling.

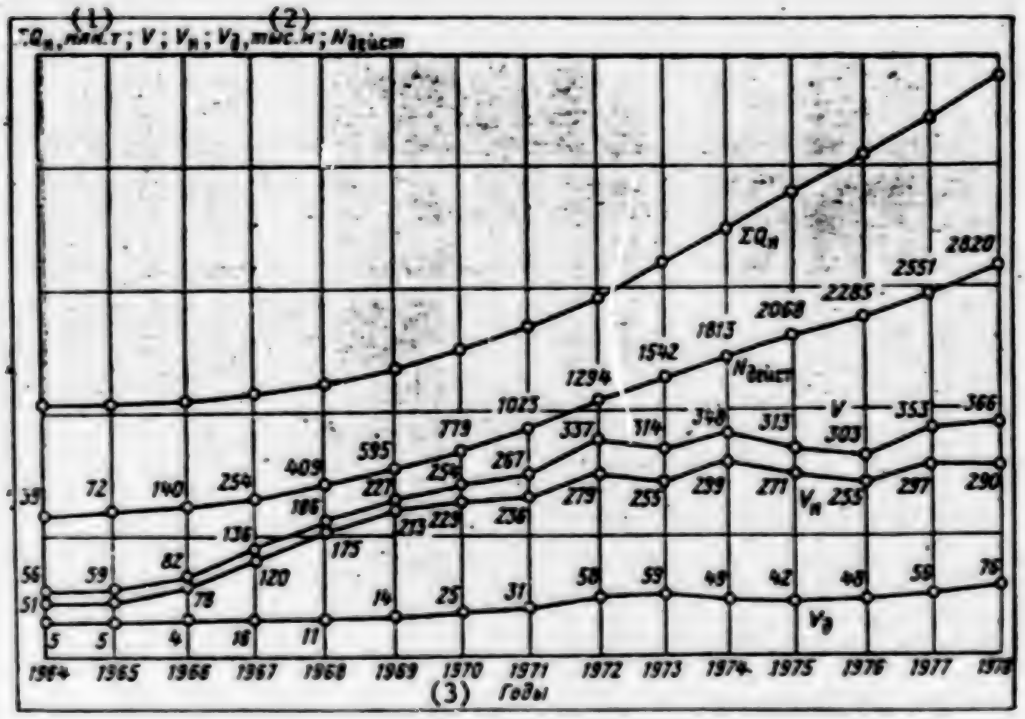

Figure 1. Indicators for Efficiency of Drilling Additional Wells

Key:

- $\Sigma Q_н$. accumulated oil extraction
- V. total number of additionally drilled wells
- $V_н, V_д$. number of additionall drilled wells to increase oil output and to obtain rated oil output respectively
- $N_{действ}$. active well fund
- 1. million tons
- 2. thousand meters
- 3. years

Analysis of the development of the Romashkinskiy field and the hydrodynamic calculations show that under conditions of its complex geological structure, the introduction of the first general plan in the original form would have provided oil output 1.5-fold lower than stipulated. In the second general plan, the number of planned wells was increased by 28.4% and additional measures were stipulated for improvement in the working system. However, despite this, because of the sparse well networks the oil output practically did not increase.

When the second and partially the third general plan were realized, a lot of work was done to improve the system of working. In 1966-1979 over 6000 wells were drilled and 1500 wells were developed for water injection (including 487 for focal and 86 for selective flooding; transfer of injection was done in 132 wells), 763 wells were switched to pumping water with increased injection pressures, and 6220 were switched to pumping operation. The pressure differential between the faces of the injection and extracting wells rose from 156.7 to 206 kg-f/cm^2. Major repairs were done numbering 19,475 (including 4062 for water insulation). The injection volume increased 1.8-fold, while liquid extraction rose 2.2-fold. A lot

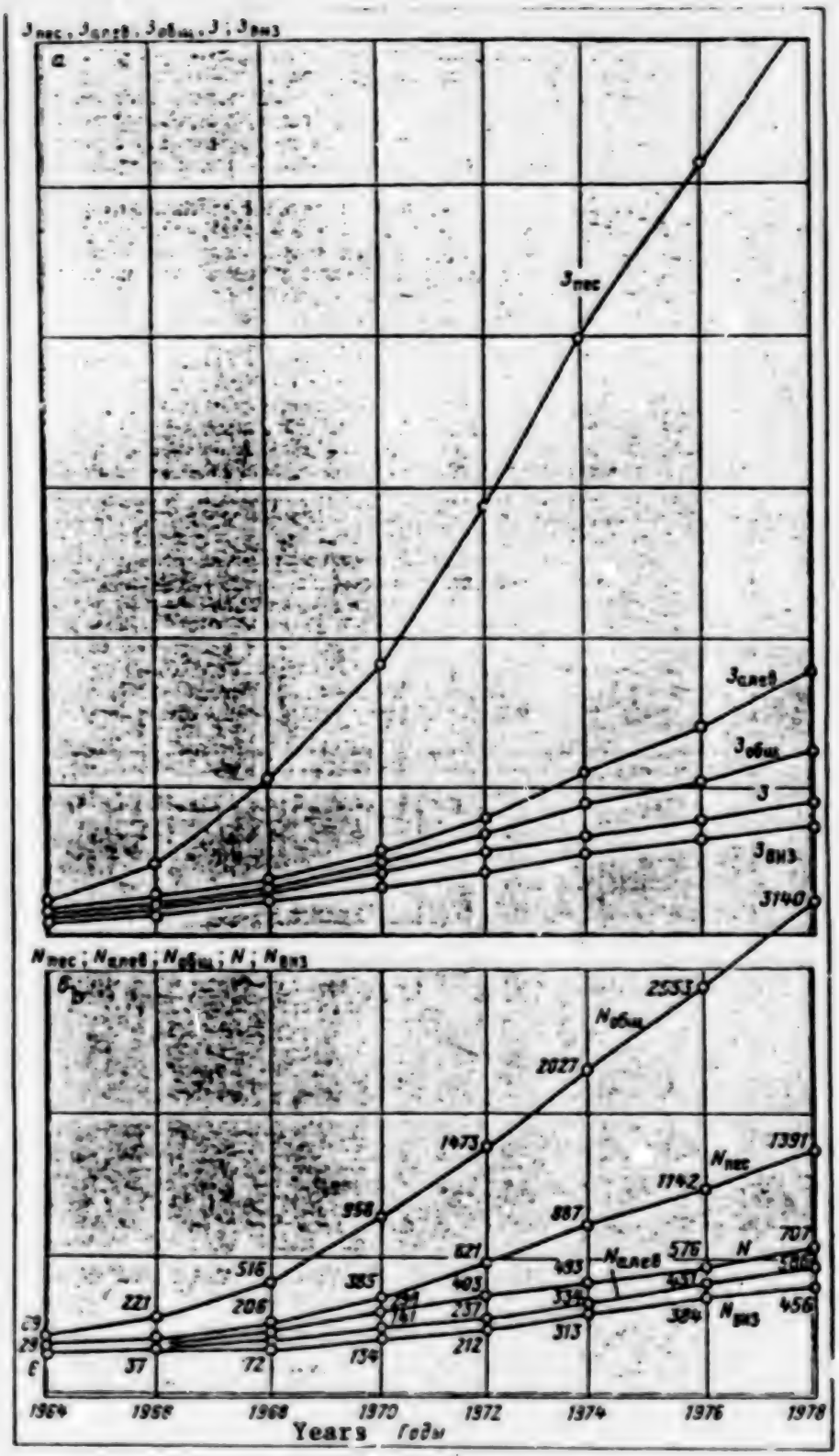

Figure 2. Dynamics of Degree of Reserve Extraction (a) and Number of Additionally Drilled Wells to Increase Oil Output of the Beds (b).

[Key on next page]

Key:

$З_{пес}$, $З_{алев}$, $З_{общ}$, $З$, $З_{ВНЗ}$. oil reserves worked, respectively: sandstones of anhydrous part not emerging onto the line of injection; aleurolites; total of all zones; sandstones of anhydrous part; water-oil zones

$N_{пес}$, $N_{алев}$, $N_{общ}$, N, $N_{ВНЗ}$. respectively the number of wells drilled on sandstones of anhydrous part not emerging onto line of injection; aleurolites; total; on sandstones of anhydrous part; in water-oil zones

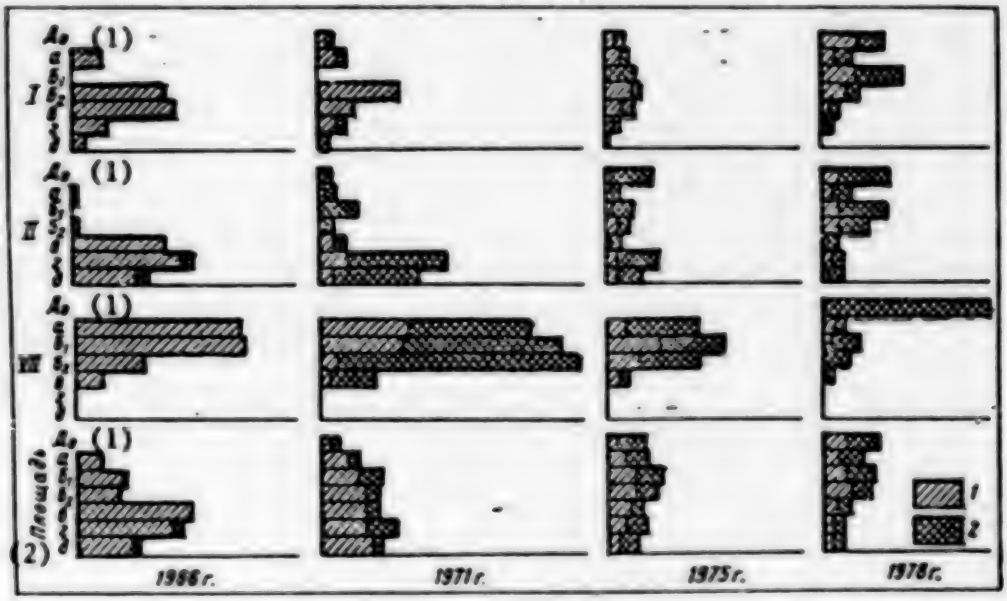

Figure 3. Change in Rates of Recovery on Certain Beds of the Minnibayevskiy Area during Operation of Wells of Original Fund (1) and Additional Drilled Wells (2)

Key:
1. before
2. area

of work was done to monitor and regulate the process of development and to introduce new methods of increasing the oil output.

Nevertheless, the introduction of the recommendations in the second general plan as compared to the first increased the oil output only by 6.1%. In order to attain the planned oil output it was required that the well fund be increased by 160% as compared to the second general plan, that all the wells be operated only by mechanized method, the ratio between the injection and extracting wells be brought to 1:3, over 2000 wells be developed for water injection, new methods of increasing oil output be widely used, and a lot of work be done annually to monitor and regulate the process of development. These measures were stipulated in the third general plan compiled in 1974-1976 for developing the Romashkinskiy field. Of them, the Ministry of the Oil Industry approved 85% of the wells for primary drilling.

We will analyze the effectiveness of optimizing the well network in the Romashkinskiy field. Figure 1 shows the effectiveness of drilling additional wells. A considerable number of wells were drilled to correct the original network and the order of their arrangement. This includes the wells drilled in a broad band between the line of injection and the zone of recovery, as well as on the sections where the distances between the operating rows were 800-1000 m.

This is governed by the fact that initially the main areas of the field were drilled out according to the theoretical conclusions [4,5] in a nonuniform network and broad bands were left between the line of injection and the zone of recovery. Subsequently, based on the generalized experience of development and the theoretical studies [6,7] the expediency was shown of using uniform networks of well arrangement. As compared to the nonuniform, they make it possible to increase oil extraction by 5-10%, to improve the conditions of working nonuniform beds, to select the most efficient system of flooding, and to increase the degree of reserve extraction. On 1 January 1979, 1583 wells were drilled in the field for uniform coverage of the operating facility (correction of the network): of the total number of additionally drilled wells, 502* were mainly to guarantee the planned oil extraction (they also promote an increase in the oil output, but to a lesser degree), and 3140 wells were to increase the oil output. Of the latter, 1391 wells were drilled to work the lens, semilens, blind zones, 456 to work the water-oil zones, 586 to work the low-permeable beds, 458 for operation of the dead zones and the remaining retained oil, and 249 for the lines of shrinking of the oil-bearing contours. Drilling of additional wells increased the rates of working and involved additional oil reserves in the development (fig 2 and fig 3).

The additionally drilled wells have already produced 186.5 million tons of oil. In 1978, 34.5% of the total extraction for the facility was obtained from them. The average oil output of the well is 23.8 T/day. This is almost triple the yield in the new fields of Tatariya.

Development of additionally drilled wells for oil was accompanied by a proportional increase in the number of injection wells. In a nonuniform, separated facility this guaranteed a proportional growth in the liquid output, and, consequently, the output of oil for the field as a whole [8].

Calculations show that if drilling of additional wells had been stopped in 1971 on the Romashkinskiy and Novo-Yelkhovskiy fields, and new fields had been drilled out, then the oil extraction in 1979 for Tatariya with larger volume of capital investments would have been almost 10 million T below the actual. Thus, drilling of additional wells permits undrainable oil reserves in individual lenses, blind and dead zones to be drawn into active working, regulation of the working of individual beds of the operating facility, and at the same time, guarantees attainment of the planned oil output.

In order to put the uninvolved oil reserves in the Romashkinskiy field into working in accordance with the suggested version of the third general plan, it is necessary

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*In contrast to our previous works [6 et al.], the wells were separated according to the final drilling goal. Some of the wells that were drilled to involve reserves of unworked beds were temporarily used to intensify the development of the operating beds.

to drill additional wells since they are not successfully recovered with the drilled fund. The experience of working the field shows that the original arrangement and condensation of the well network are effective if the main oil reserves of the operating facility are included in the active working in addition to the use of the flooding system. Final condensation is effective when all the oil reserves of the operating facility are included in the working and high (economically permissible) oil output is attained.

Table 2

Fields	Average yield of one active well		Average yield of a new well	
	with maximum extraction	in 1979	with maximum extraction	in 1979
Romashkinskiy (levels D_1, D_6)	39	21	73	16.9
Novo-Telkhovskiy, Bablinskiy, Tat-Kandyzskiy, Bondyuzhskiy, Pervomayskiy (confined to the Devonian)	32.2	23.8	59.3	10.2
Romashkinskiy, Novo-Yelkhovskiy, Sabanchinskiy (facilities confined to the Carboniferous)	13	14.4	13.7	11.1
Others to be worked	7.6	9.2	16.7	7.1
Introduced in 1979-1980	3.5	8.1	11.4	8.1
On the whole for the Tatneft' association	24.3	19.7	26.8	13.8

A comparison of the actual and the planned indicators for operation of additional wells in the Romashkinskiy field with the indicators of working other fields of Tatariya which have been worked and are going to be put into operation shows that the effectiveness of drilling additional wells is considerably higher: the relative outlays are 6.7-fold lower, the specific capital investments for 1 T of oil are 10-15-fold lower, and the average yields are 2.5-fold higher (table 2). The yields of the additionally drilled wells are more stable (fig 4).

The change in the system of working, especially the density of the well network is governed by the introduction of new methods for improving the oil output. New methods for improving the oil output for "additional washing" of the oil from the partially or completely flooded beds will evidently be suggested for the Romashkinskiy field in further planning. There is no doubt among the majority of specialists of the need for using denser networks of wells.

The very sparse original networks of wells required repeated (3-5-fold) additional drilling out of the field to bring them to the optimal that should be selected at the stage of compilation of the technological plan for development. Thus, the preliminary technological plan for working the Abdrakhmanovskiy field in 1954 provided for drilling 376 wells. The refined plan of development in 1957 provided for 676 (including 160 reserve), the refined 1964 plan provided for 919 (including 70 reserve), the complex 1975 plan stipulated 1579 (including 210 reserve), the 1978 development plan provided for 1964 (including 106 reserve), and the third general plan stipulated 2223 wells. In this case the density of the network increased 6-fold.

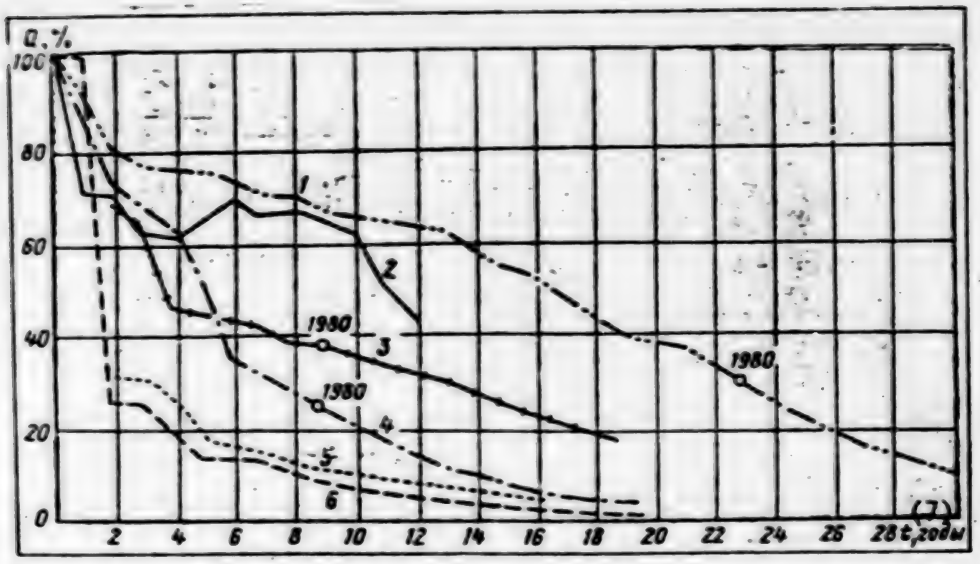

Figure 4. Dynamics of Well Output for Romashkinskiy and Other Fields of Tatariya (Maximum Output of Wells Drilled above the Original Fund Taken as 100%. All Levels of Maximum Extraction Are Presented for One Year).

Key:

1,2. Romashkinskiy field (levels D_1, D_0) respectively for wells of the entire operating fund and wells drilled above the original fund
3. Shegurchinskiy field (Turneyskiy stratum)
4. Ul'yanovskiy field (Tula and Bobrikovskiy levels)
5. Sirenevskiy field (levels D_1, D_0)
6. Yamashinskiy field (Tula and Bobrikovskiy levels)
7. years

The Abdrakhmanovskiy field was drilled out in four stages. At first, three operating rows were drilled at a distance of 2000 m from the injection line. Then central cutting and drilling were done of the so-called two zero operating rows at a distance of 1300 m from the injection line. Further, additional rows of wells were drilled between the operating rows previously drilled every 1000 m, as well as wells in a band 1300 m wide between the injection line and the recovery zone. Only after drilling 1200 wells was the area covered by a uniform network of wells and was the greater part of the IER successfully involved in development. Currently, selective drilling of wells is being done to involve the remaining unworked reserves in development.

As a result, instead of two-stage drilling out, multistage was carried out on the area. This is explained by the drilling out of all the wells of the main and reserve fund by the end of each stage, and by the absence of wells for drilling whose fund had to be defined at different stages. A total of 13 planning documents were compiled. If the area had been immediately drilled out according to two independent uniform well networks, then the original fund would have consisted of 1720, and the reserve of 503 wells. Drilling of the main fund would have allowed the main reserves to be involved in the development. The maximum output of oil would have been 25% above the actually attained, and would have been obtained 5 years earlier with the same volumes of drilling and outlays.

As shown by the studies of specialists of TatNIPIneft' and scientists of Kazan' University, the characteristic size of the heterogeneities in the Devonian beds of the Romashkinskiy field comprise about 400 m, while the aleurolites can only be included in development when the distances between the injection and extracting wells averages about 300-400 m. The Devonian oils have a high initial displacement gradient, and reserves will not be worked with distances between the injection and extracting wells greater than the permissible (this especially refers to the collectors with permeability of less than 300 mD). Therefore, before the economically permissible thinning of the well network is defined, it is necessary to know the technologicall permissible limits of its thinning for different geological-physical conditions.

In establishing the economically permissible oil output. one should start from the conclusion proved by the experience of development that the density of the network has a significant effect on the oil output, and the more significant the effect, the more nonuniform the bed and the worse the rheological properties of the fluids saturating it. In this case it is necessary to use the dependences of oil output on the density of the well network that were obtained for real geological-physical conditions, and the outlays to increase the extracted oil reserves as a result of increasing oil output should be compared with the outlays for increase in 1 T of oil reserves because of the exploration of new fields with regard for the structure and quality of the oil reserves, specific outlays for extracting 1 T of oil on the operating and explored fields. The cost of preparing the oil reserves must be accepted not as the average for the branch, but for the regions with low efficiency of geological exploration.

Thus, additional wells were mainly drilled to attain the planned oil output. As shown by the calculations, it would have been 1.5-fold lower than the planned if the original decisions had been introduced. In working multiple-bed fields with nonuniform collectors by the flooding methods, the arrangement of the wells on the deposit has decisive importance for increasing the rates of oil extraction and oil output. Condensation of the well network is one of the main methods for increasing the rates of oil recovery and improving oil output. Drilling additional wells on the Romashkinskiy field is economically more efficient than developing less productive fields.

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RELIABLE RAW MATERIALS BASE FOR THE OIL INDUSTRY

Moscow NEFTYANIK in Russian No 12, Dec 80 pp 16-19

[Article by M. Sattarov and S. Malakhovskiy: "Reliable Raw Materials Base for the Oil Industry"]

[Text] The history of evolution of the oil industry indicates that continuous growth in oil extraction in our country was guaranteed by the timely discovery and industrial development of new oil and gas provinces, oblasts and regions. The problem of the timely evolving of geological exploration in new oil and gas provinces was always the subject of special concern of the party and government. A clear example of this is the important decisions and decrees that were adopted by the CPSU Central Committee and the USSR Council of Ministers for the accelerated development of the West Siberian natural resources. These decisions are now being successfully implemented.

The stable development of the oil industry, and more so, an increase in the rates of oil extraction are inseparably linked to exploration and prospecting on oil fields, and the timely preparation of oil reserves of industrial categories.

Industrial fields are usually confined to definite regions with geological conditions that are favorable for the formation, migration and accumulation of oil. The sites of concentration of a group of fields form regions, which in turn become oil-and gas-bearing oblasts. The set of oblasts comprises the oil and gas province which unites an isolated territory which is considerable in dimensions and thickness of the sedimentary rocks. In the section of sedimentary deposits, the oil fields are confined to definite stratigraphic complexes, for example, the Devonian, Carboniferous and Permian in the Bashkir oil and gas oblast which is a part of the Volga-Ural province. Scientifically substantiated separation of the oil and gas provinces, oblasts and regions, as well as the stratigraphic complexes is the main condition for the successful conducting of exploration and prospecting work.

Exploration and prospecting of oil fields is a complicated technological process that can be divided with a certain conditionality into a number of stages.

At the first stage, the general geological structure of a certain territory is studied for the purposes of establishing its possible oil and gas content. These studies, called regional, include a method of analogy, comparison with other oblasts and provinces, drilling of reference parametric wells to a great depth, large-scale geophysical work, and in recent years also studies based on space

photographs. Their duration varies and often they are very prolonged. Thus, the regional studies of the Ural-Volga and West Siberian regions were started back in the last century. Their result has been a prediction evaluation of the oil and gas content with setting of approximate reserves for group D.

The second stage is preparation of the structures for deep exploratory drilling. For this purpose, a detailed study is made of the geological structure of the oblast or its individual regions by geophysical methods (seismological exploration, gravimetric exploration, etc.). Core-exploratory wells are drilled. As a result, the necessary section of structures is created which is used to make a quantitative evaluation of the long-term reserves according to category C_2.

The third stage, exploration of the oil fields, includes drilling deep exploratory wells whose main purpose is to discover oil fields and evaluate their reserves according to category C_1.

The fourth stage consists of a detailed exploration of each discovered field by deep development wells and obtaining of the original factual data to compute the oil reserves of industrial categories $B+C_1$. Based on the computed and confirmed reserves, the field is put into operation according to the development plan. The reserves that are covered by the development are transferred to category A.

The first two stages are usually united into a single geological exploration stage, while the third and fourth comprise the exploration-prospecting stage. Each of the listed stages is a complicated process in the overall chain of geological exploration. They are implemented with the use of highly sensitive equipment and modern instruments. Technical and economic indicators for the duration of work, labor intensity and current outlays are established to characterize them.

The periods for developing individual oil and gas oblasts are formed of the time expenditures for regional research t_1, preparation of the structures t_2, exploration of the fields t_3 (fig 1). Another time interval t_4 is required from the beginning of the prospecting work to organization of industrial extraction of oil. At the moment in time $T = t_1+t_2+t_3+t_4$, when reserves of industrial categories $B+C_1$ have been prepared in sufficient quantity, extraction of oil begins. In this case, the categories of reserves are systematically raised. In the initial stage, a transition is made from the predicted evaluation of the reserves for group D to long-term C_2, then to reserves of industrial categories C_1 and B, and after organization of extraction, to category A.

Any oil and gas oblast passes the listed stages of development of geological exploration, and each subsequent stage begins when the previous has not yet ended. Therefore the degree of study of the region and development of its resources at any moment of time are presented best of all in the form of a diagram (fig 2). The height of the column characterizes the original, 100%, potential oil resources (OPR) which at any moment of time from the beginning of development are formed of oil extraction Q_c which has been accumulated since the beginning of development of the region, its reserves of industrial categories $A+B+C_1$, the long-range reserves C_2 and the predicted evaluation of the oil and gas content according to group D. The correlations between them change quite naturally in time.

At the original stage of geological exploration (fig 2,a) the operational drilling has not yet begun, however the oil reserves of industrial categories $B+C_1$ are already present in quantities necessary to set up extraction. A number of structures

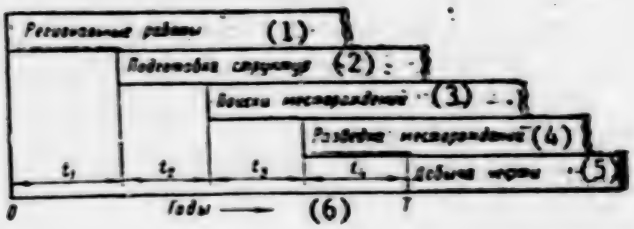

Figure 1. Sequence of Development of Oil and Gas Oblast

Key:

1. Regional work
2. Preparation of structures
3. Exploration of fields
4. Prospecting of fields
5. Extraction of oil
6. Years

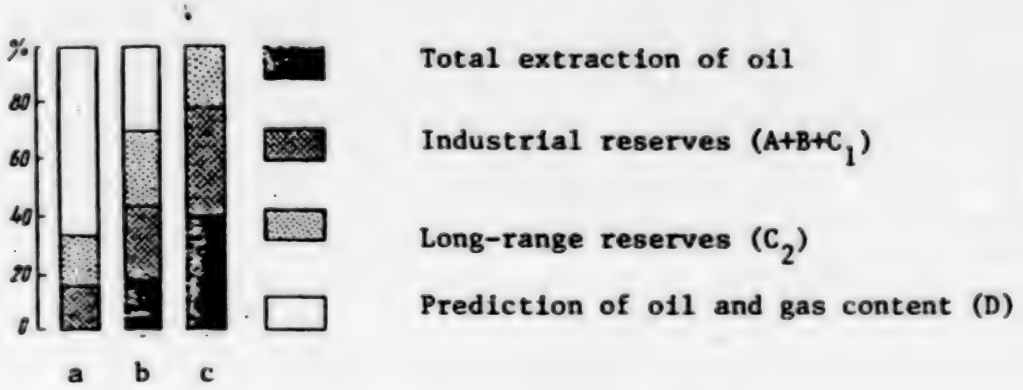

Figure 2. Diagrams of Condition of Development of Potential Resources of Oil

thatare sufficient for further development of exploration-prospecting work are also prepared. They are used to compute the long-range reserves C_2. The remaining part of the OPR consists of predicted evaluations of category D.

The distribution of resources in the region changes with time. Part of the oil reserves have already been extracted, reserves of industrial categories $A+B+C_1$ and long-range reserves C_2 have increased, and a corresponding reduction in the predicted evaluation has occurred (fig 2,b).

At the late stage of field development, the reserves that comprise the extractable portion of the original potential resources have already been recovered to a considerable degree, but reserves of the industrial categories and a small part of the long-range still remain (fig 2,c). The territory of the region has been completely studied, and there are no reserves for the prediction evaluation.

Such main indicators as degree of exploration of the region, degree of extraction of reserves and effectiveness of deep exploratory-prospecting drilling are used for quantitative evaluation of the condition of the region at different moments in time.

The degree of exploration of the region, oblast and province n_p is the ratio of the sum of reserves in categories $A+B+C_1$ and accumulated extraction Q_c to the original potential resources (OPR):

$$n_p = \frac{(A+B+C_1)+Q_c}{OPR}.$$

The degree of extraction (output) of reserves $n_{изв}$ is defined by the ratio of accumulated extraction Q_c to OPR:

$$n_{изв} = \frac{Q_c}{OPR}.$$

The quantities n_p and $n_{изв}$ can be expressed both in percentages of a unit, and in percentages.

The effectiveness of deep exploratory-prospecting drilling is evaluated by the increase in oil reserves of categories $A+B+C_1$ per 1 m of tunneling, T/m. This indicator can also be presented in a monetary expression as the specific outlays for 1 T of increase in reserves, R/T. It is also expressed as the increase in reserves per 1 R of expenditures, T/R or by the quantity of increase in reserves per 1 exploratory-development well, T/well. We will further use the quantity T/m.

These indicators allow us to establish a number of features in the process of preparing the oil reserves.

We note first of all that a stable dependence exists between the effectiveness of the exploratory-prospecting drilling and the degree of exploration of the region (fig 3, curve 1): at the initial stage of geological exploration, their effectiveness is low, then it rises sharply, and reaches the maximum value by the time of roughly 20-percent exploration of the region, after which it begins to drop. By the moment of 100-percent exploration of the region, the effectiveness of the exploratory-prospecting drilling approaches zero.

It is simple to explain this nature of the dependence of the effectiveness on the degree of exploration. In the initial stage of exploration of the region, the main laws governing the arrangement of the oil fields have still not been studied, and correspondingly, the optimal methods have still not been developed for geological exploration. Therefore there is an element of randomness in the discovery of the fields, and the effectiveness of deep developmental drilling cannot be high. As the degree of study of the region rises and general laws governing the distribution of oil in the section are discovered, larger fields are found and the effectiveness reaches the maximum. Further condensation of the network of development wells guarantees the discovery of fields with smaller reserves. This leads to a natural reduction in effectiveness.

Consequently, in order to guarantee the assigned increase in oil reserves at the late stage of exploration of the region, an ever greater number of exploratory-development wells has to be drilled, and in the final analysis, a stage of exploration of the region develops where the outlays to increase the reserves reach the maximum permissible amount.

The oil and gas oblast, and more so, the oil and gas province, consist of several regions for each of which we can plot its own curve of effectiveness of exploration-prospecting work. It is easy to guess that in order to maintain high effectiveness of work for a long time for the oblast or province as a whole, it is necessary to prepare more new regions in time for exploratory-prospecting drilling and

industrial development. However, in limits of the oblast and the province, the number of these regions is not unlimited. With time, when all the oblast regions have already been explored to a sufficient degree, the effectiveness of preparing reserves begins to drop, first for the oblast, and then for the province. If work to find and study new oil and gas provinces is not started in time, the decline in effectiveness of the exploration-prospecting work will be inevitable for the country as a whole. In order to prevent this from happening, we have to simultaneously search for new oil and gas provinces and organize scientific research work to maintain the effectiveness of the exploration on the tested territories.

Thus, two main target programs are isolated which are aimed at increasing the raw materials resources of the oil industry. The first of them has the goal of further increase in the potential oil resources by conducting extensive regional studies in new oblasts and provinces. The second program is aimed at improving the effectiveness of the exploration-prospecting work in the oblasts with studied oil and gas content, in which the increase in reserves per 1 m of deep exploratory drilling declines because of the attainment of a high degree of exploration of the potential resources. Each of these programs requires the corresponding outlays. Realization of the first program requires especially large outlays since preparation of the raw materials resources is carried out in new, generally uninhabited regions, with severe natural-climate conditions, but these outlays are rapidly compensated for in the future. The second program requires lower, but on the whole also large outlays. The work here does not end with such significant discoveries. However, the discovery of small fields and new deposits on known fields in this case is done in regions located near to the developed territories. Relatively lower resources are spent for the further inclusion of these fields and deposits in development. The final effectivenss of these discoveries is fairly high.

According to the methods of program-target planning for the development of the oil industry, the development of the examined programs is carried out in the following sequence. Based on the needs of the national economy for oil and petroleum products, the levels are defined for oil extraction for the future, and then the increase in its reserves is established which can guarantee this extraction. The increase in reserves which is the purpose of the geological exploration, should be distributed over the individual oil and gas provinces (old and new) so that the expenditures of material-technical, labor and other resources are the minimum. In this case, it is necessary to take into account that the development of new oil and gas regions and oblasts must be planned with regard for the long-term outlook for development of the oil industry. Geological exploration in them should be started way in advance.

It is necessary to start way in advance because at the current stage, further increment in the raw materials resources of the extracting sectors is generally tied to the development of the eastern and northern regions. At the same time, the interests of developing the country's national economy require that this advance be the shortest possible.

Thus, the first program is reduced to decreasing the time before the beginning of industrial extraction of oil T (see fig 1) by means of each of its components t_1, t_2, t_3, t_4, and the second is reduced to a change in the formed effectiveness of deep development drilling (fig 3, curve 2) so that it remains high even with a considerable degree of exploration of the region.

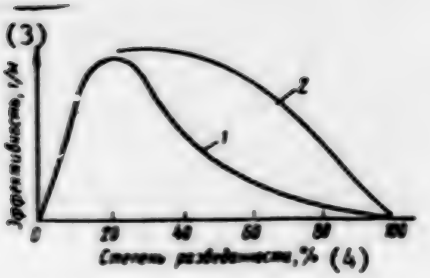

Figure 3. Dependence of Effectiveness of Deep Development Drilling on Degree of Exploration of Region

Key:

1. Without measures to increase effectiveness
2. With the use of measures
3. Effectiveness, T/m
4. Degree of exploration,%

We will examine in more detail the components t_1, t_2, t_3, t_4 of the total period of development T of a new oil and gas oblast, and the ways to reduce them.

Time t_1 is the minimum period needed to attain that level of regional degree of study in which the oil and gas content of the province has been proved and the prerequisites have been created for the successful conducting of the next stage, the detection and preparation of structures. In practice, the province or oblast is generally studied to a sufficient degree by the beginning of this stage only on a limited part of the territory which includes one, less often two major tectonic forms. This drastically reduces the success of the stage of detection and preparation of the structures. It is therefore necessary for the regional study to cover larger territories. This will accelerate the subsequent rates of development of the oblast as a whole.

Time t_2 necessary to detect and prepare the structure fund which guarantees the discovery if only of one field and which justifies the further evolving of the front of geological exploration work is defined from the formula

$$t_2 = \frac{D}{K_o d},$$

where D--volume of geophysical work to detect and prepare one local structure; d--annual plan of geophysical work for the corresponding period; K_o--success factor of the initial period of preparation of reserves.

Analysis of the presented ratio shows that reduction in t_2 under the given geological conditions is attained by increasing the volume of detailed geophysical work. This is limited by the power of the organizations who are doing the work, as well as by the preceding degree of regional study which guarantees great success. The quality of conducting the first stage of geological exploration has an effect precisely here.

The time interval t_3 is defined as the time for accumulation of oil reserves which justify the beginning of its extraction in the region with minimum risk. Their

quantity is greater, the greater the specific capital investments for the examined oblast as compared to the average branch indicators

$$t_3 = \frac{\Omega}{\Im V_0},$$

where Ω--accumulated reserves, T;
$\Im$--initial effectiveness of deep development drilling, T/m;
V_0--volume of drilling, m/year.

The potentialities for reducing time t_3 are hidden in the increase in volumes of deep development drilling. This in turn is determined by the effectiveness of the previous stage of work, the quantity and degree of preparation of the structures.

Time t_4 which is necessary to fulfill the minimum volumes of field development and creation of the infrastructure to guarantee the beginning of industrial operation depends on the natural-geographical conditions of the region, its distance from the railroad lines and main pipelines, the dimensions of the fields and the properties of the oil. The experience of developing new oil regions shows that in certain situations, t_4 can equal zero, if extraction of oil begins from the fund of development wells without field development. However, it is undesirable to orient oneself on this "experience" since this further results in restraint of oil extraction. For example, in the development of the fields of the northern slope of Alaska, construction of the main oil pipelines was delayed and the developing wells could not be used in full power.

By using the presented formulas and considerations, as well as the domestic and foreign experience, we can define with sufficient degree of accuracy the volumes of geophysical studies and exploratory-development drilling that can guarantee the beginning of industrial extraction of oil in the oblast in the assigned periods.

As an example we will look at the process of developing the North Sea by international oil monopolies. Geophysical studies to reveal and prepare the local structures in this region were started in 1959. Within 5 years, in 1964, the first well was made. This started the stage of evolution of the exploratory-development drilling operations for oil. Accumulation of industrial reserves of oil was started in 1969 when the Ekofisk field was discovered in the Norwegian sector of the sea. Extraction of oil in small volumes was started in 2 years, in 1971. In the next 5 years, extraction did not exceed 1.5 million T/year because of difficulties in collecting and transporting the oil from the drilling platforms. Only in 1976 did uniform increase in extraction start, after the end of construction of an underwater oil pipeline. Thus, 12 years passed from the moment the original regional studies were completed to the beginning of experimental operation, and 17 years to the moment of evolution of extraction.

Development of new oil and gas regions in the USSR must be done in shorter periods. For this purpose creation of the material and technical base is continuing, new equipment and technology are being developed and introduced, and extensive scientific research work has been organized.

Realization of the second target program, increase in the effectiveness of geological exploration in the traditional regions with a developed industrial base and oil field facilities is no less important in guaranteeing rising levels of oil

extraction. The effectiveness of extensive development drilling is determined according to the following formula

$$\Theta = \frac{1}{h} \cdot \frac{\omega}{\frac{1}{K_y} N_n + N_p},$$

where h--depth of occurrence of the productive levels;
ω--average reserves of industrial categories on one discovered field;
N_n, N_p--number of exploratory and development wells of one field;
K_y^p--success factor which is the ratio of the number of oil-bearing structures to the total number of structures on which the field exploration is carried out.

All the parameters included in this formula, with the exception of the depth of occurrence of the productive beds h, can be affected to a certain measure. Thus, the average reserves on one field and the success factor may be increased, if extensive geophysical studies are made in time and a large fund of structures is created which are then put into exploratory drilling according to the degree of size and reliablity. The number of exploratory wells cannot be less than one, but there is always the possibility of reducing the number of development wells by broader use of the methods of field geophysics, increase in the volume of hydrodynamic studies, as well as combination of industrial exploration of the fields with drilling of producer wells.

We note in conclusion that in order to realize both the first and the second program, it is necessary to have a high quality in the geophysical studies, and extensive involvement of space methods and modern computer equipment. The timely fulfillment of this work will permit a future reliable supply of oil and petroleum products to the national economy.

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DAGESTAN A LEADER IN THERMAL, SOLAR ENERGY UTILIZATION

Moscow PRAVDA in Russian 5 Jul 81 p 3

[Article by A. Gadzhiyev, deputy chairman of the Dagestanskaya ASSR Council of Ministers and chairman of the republic's gosplan (Makhachkala): "Pent-up Energy"]

[Text] A reader continues the discussion.

I read with interest the article by P. Shvetsov and I. Dvorov, "Not Only Hothouses...." (PRAVDA, 12 March). Its authors' recommendations are urgent and deserve support. Actually, renewable underground energy must be placed at the people's service rapidly and completely. That is why it is necessary to continue the discussion.

The country is now operating 36 fields (170 operating wells) to recover 40 million cubic meters of hot water and 300,000 tons of steam-and-water mix per year. This permitted district heating for 4,500 apartments, a hot-water supply for 300,000 people, the heating of 50 hectares of hothouses, and the generation of 16 million kilowatts of electricity in 1979.

The earth's heat has been put to the economy's service in the North Caucasus, in Georgia, on Kamchatka, in the BAM [Baykal-Amur Mainline] zone and in the Ukraine, in one way or another. In the first three areas there are industrial administrations for use of the earth's deep heat, which are incorporated in the USSR Mingazprom [Ministry of Gas Industry] system. Thus geothermal wells that are operating in Dagestan yield daily more than 50,000 cubic meters of hot water for enterprises.

For almost 20 years now thermal water has been in use in the country on an industrial scale. It has been confirmed that geothermal resources can compete successfully with traditional types of fuel. And the prime cost of the final product is comparatively low for the customers.

An All-Union conference entitled, "National-Economic and Standard-Practices Problems of Geothermal Energy," which met in June 1978 at Makhachkala, noted in its resolution: Dagestan, where substantial practical results have been achieved in using the earth's hot underground water, has a leading place in reserves of the Earth's deep heat.

Yes, we have hot water, which is obtained from wells of the petroleum inventory, and it has been used for heating purposes since 1940. Fourteen years ago the

country's first industrial administration for use of the earth's deep heat was established at Makhachkala, and the drilling of geothermal wells began. In the past 10 years this administration has realized more than 50 million cubic meters of hot water, saving more than 330,000 tons of standard fuel equivalent.

Research by specialists of the institutes of physics and geology of the Dagestan Branch of the AN SSSR [USSR Academy of Sciences], the Dagestan Branch of ENIN [Power-Engineering Institute] imeni G. Krzhizhanovskiy and other organizations have helped in developing geothermal power engineering on an industrial scale in the republic. The creation of the Institute of Geothermal Problems under the Dagestan Branch of the AN SSSR is testimony to recognition of the successes of the republic's scientists in this area.

Our republic has huge thermal water resources. Total forecasting operating reserves have been evaluated at several millions of cubic meters per day, with a heat potential equivalent to tens of millions of tons of standard fuel equivalent. Even their partial use will enable the republic's fuel and energy balance to be improved by far.

Deposits of steam and thermal water and of rare-metals water have been found in Dagestan. During drilling in the Tarumovka area, a well with a steam-and-water mix (12,000 cubic meters per day), which has been capped, flowed from a depth of 5,429 meters. According to computed data, the pressure at the wellface approached 800 atmospheres at a temperature of 220-240 degrees Celsius. Based upon this underground "boiler," according to the computations of scientists of the Riga Division of Teploeleketroproyekt [Institute for the Design of Heat and Power Centrals], it is possible to build a geothermal electric-power station of 400,000 kilowatts' capacity. And there is also water of the Tarumovka type at other places--at Adzhi, Achi-Su and Berikey.

The brine of these fields can be a good raw-materials base for obtaining rare-earth elements. Industrial tests on a laboratory scale conducted at the Sukhokum and Berikey deposits by scientists of some of the country's scientific institions have confirmed this.

USSR Gosplan in 1979 adopted a decree that called for first-priority measures to organize better use of renewable energy sources. Concrete tasks were set for the Dagestanskaya ASSR. Among them were the drilling of appraisal wells and of doubler wells at the Tarumovka field and the development of a feasibility study for the construction of geothermal electric-power stations and of an industrial test installation for extracting rare metals from thermal water.

In accordance with this decree, USSR Minenergo [Ministry of Power and Electrification] is completing the development of documentation for the construction in the republic of a large geothermal electric-power station and is continuing the development of a feasibility study for the erection of an industrial-test installation, based upon the Tarumovka field. The All-Union Scientific-Research and Design Institute for Aluminum and Magnesium and the Electrode Industry is developing a feasibility study for the erection in Dagestan of an industrial-test installation for extracting rare metals from thermal water at the Yuzhno-Sukhokum field.

However, the thermal water is only a part of the earth's underground heat resources. The main reserves of heat are accumulated in rocks at depths of 4,000-5,000 meters. The temperature of the "dry" rocks exceeds 200 degrees Celsius. Estimates

of scientists and specialists indicate that, with the conversion to progressive methods for preparing the water and for repumping it into the reservoir, geoTES's [geothermal electric-power stations] of great capacity will be economically feasible in Stavropol'skiy Kray, Zakarpatskaya Oblast and the Dagestanskaya ASSR.

Fields of steam and hot-water springs that have been observed in so-called nonvolcanic regions are next in line in the development of high-temperature geothermal power engineering. As has been explained, interior depressions and intermontane depressions are high-capacity basins with up to 10,000 square kilometers of thermal water at temperatures of about 200 degrees Celsius. Three such basins have been found within the mountainous part of Dagestan. By using this hot water it will be possible to save up to 2 million tons of standard fuel equivalent annually and 150 million cubic meters of fresh water in the long term.

Our republic also has favorable conditions for developing wind and solar energy. Wind conditions make it possible to site wind electric-power stations of 5,000-10,000 kilowatts capacity or more within the republic and to connect them to the country's Unified Electric-Power System. Moreover, wind energy units with capacities of 1 to 30 kilowatts can help to mechanize the delivery of water to pastures and to electrify animal husbandry, irrigation and water distillation. A wind unit of 6 kilowatts capacity has been put into test operation in our republic.

Solar energy also can be used effectively. In accordance with a decision of the USSR State Committee on Science and Technology, three experimental rural-type apartment houses with solar heating systems are being built in different parts of Dagestan. A centralized system for a solar heat supply for apartment houses is being developed in the power-engineering workers' settlement of the Irganayskaya GES, and a rural bathhouse with a solar water heater is in operation. Other work is also being conducted in the oblast.

In recent years a number of the republic's scientific organizations have had fruitful creative contacts with the Institute of High Temperatures of the AN SSSR. The experimental "Solntse" proving ground is being erected in the republic, where experimental models of solar installations for heating water and housing, for air conditioning, for heating greenhouses, and for distilling water will undergo approval tests. According to our calculations, in the long term renewable energy sources will gradually displace traditional types of fuel.

Our country has great reserves of gas and coal. Unfortunately, this engenders an indifferent attitude toward "minor" energy sources.

Renewable sources for generating electric power and for raising oil yields are not being used adequately. A large number of wells are inactive. According to forecasts, 25 million cubic meters of thermal water per day with temperatures of 40-200 degrees Celsius can be obtained, and fields with a flow of just about 400,000 cubic meters per day have been explored and confirmed, but actually only 80,000 cubic meters and 7,000 tons in the form of steam are being used. The generation of electricity based on the use of underground heat has been confined for a long time in the country solely to the Pauzhetskaya Industrial-Test Geothermal Electric-Power Station.

The exploration of deposits and the confirmation of thermal water reserves is proceeding very slowly. Out of 16 thermal-water intakes at work in the North Caucasus,

there are only three operating reserves that have been calculated and confirmed: the Makhachkala-Ternair, Khankal'skoye and Cherkesskoye fields. Meanwhile, it is impossible to prepare design and budget-estimating documentation and to allocate appropriations for the construction of thermal-water outlets (the drilling of operating wells and the buildup of the support facilities) at enterprises that use geothermal resources without the approval by the USSR State Commission on Mineral Reserves of the thermal-water reserves to be operated.

USSR Mingazprom pays little attention to geological prospecting for thermal water, and prospecting is done irregularly.

A lack of improvement of the price-setting system slows the development of geothermal energy. The release price for water from hot underground sources, as they say, still has not been put together. Someone (it is not known just who) at one time set it at the level of ordinary fresh water--6 kopecks per cubic meter. In accordance with what scientific substantiation or computations? It is time to approve prices for thermal water that take into account its characteristics (the thermal-energy potential and the chemical content) and also the costs of the services for extracting it and preparing it for transport.

And now briefly about other problems. The chemical elements, which are valuable and extremely necessary to various branches of the country's economy, still are not being used on an industrial scale. There are no designs for industrial-test installations at which it would be possible to perfect more effective operating schemes for the integrated extraction of salts and elements. The output of specialized equipment for monitoring the recovery of geothermal water has not been arranged. Little work has been done on design-development and testing of water treatment or on the design of heat exchangers.

It is necessary, finally, to find a sponsor for the problem--one that is zealous and solicitous. Many see one in the form of a state organ that would work out a master scheme and regional schemes for the integrated use of geothermal resources and would realize them through its regional subdivisions. Such an organ should have its own supply and equipment base and research, design and surveying subunits. Then it will become possible to increase gradually the economically justified extent of involvement of renewable energy sources in the country's fuel and power balance.

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